

DATA HIGHLIGHTS

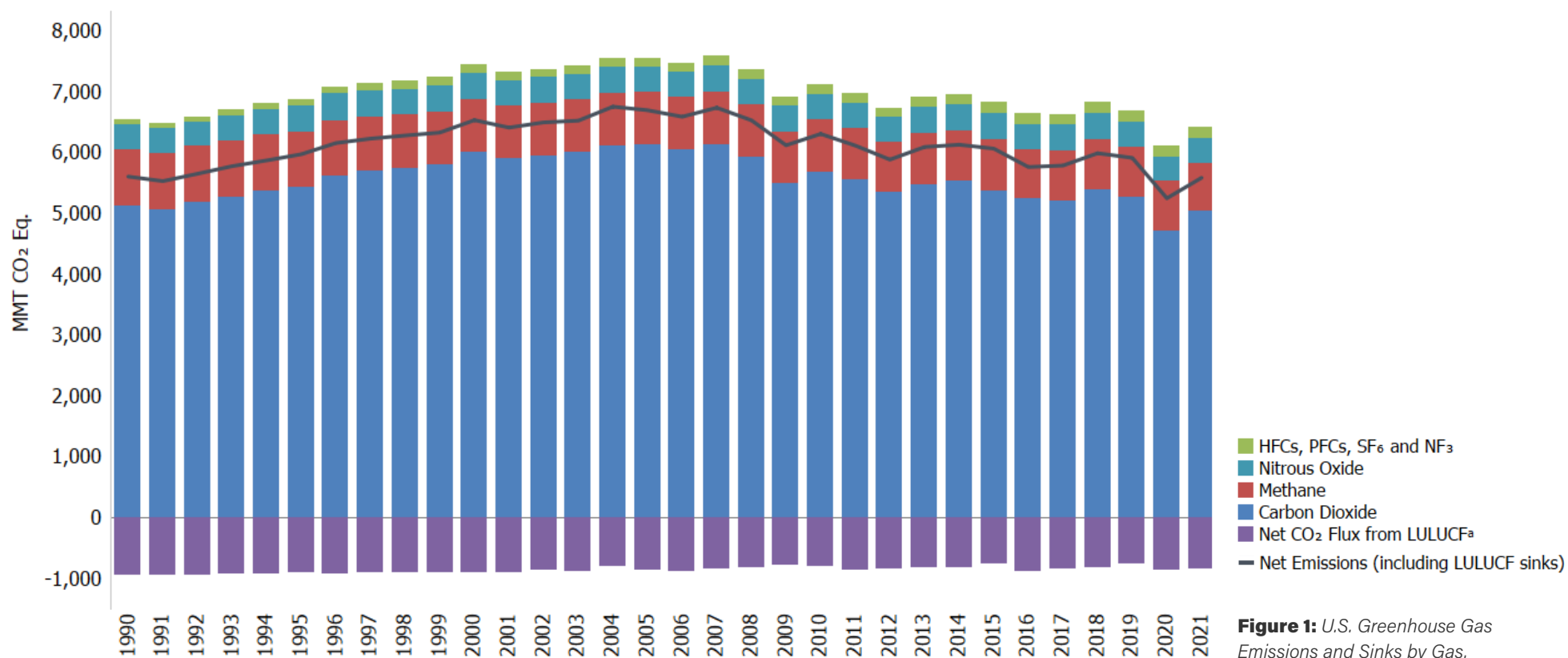
Inventory of U.S. Greenhouse Gas
Emissions and Sinks: 1990-2021

HIGHLIGHTS OF RECENT TRENDS

- In 2021, net U.S. greenhouse gas emissions were 5,586 million metric tons of carbon dioxide equivalent (MMT CO₂ Eq.).
- Overall, net emissions increased 6 percent in 2021 due to economic activity rebounding after the height of the COVID-19 pandemic.
- Net emissions were 17 percent below 2005 levels. The recent decline is mostly due to a shift to less CO₂-intensive natural gas for generating electricity and a rapid increase in the use of renewable energy in the electric power sector.
- Transportation activities accounted for 29 percent of total U.S. greenhouse gas emissions in 2021.
- Emissions from electric power accounted for the second largest portion (25 percent), while emissions from industry accounted for the third largest portion (24 percent) of total U.S. greenhouse gas emissions in 2021.
- The Land Use, Land-Use Change and Forestry (LULUCF) sector offset 12 percent of total emissions in 2021.

TRENDS IN U.S. GREENHOUSE GAS EMISSIONS AND SINKS

Overall, from 1990 to 2021, total emissions of carbon dioxide (CO₂) decreased by 2 percent, total emissions of methane (CH₄) decreased by 16 percent, and total emissions of nitrous oxide (N₂O) decreased by 3 percent. During the same period, emissions of fluorinated gases including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF₆), and nitrogen trifluoride (NF₃) rose by 105 percent. U.S. greenhouse gas emissions were partly offset by carbon sequestration in managed forests, trees in urban areas, agricultural soils, landfilled yard trimmings, and coastal wetlands. These were estimated to offset 12 percent of total gross emissions in 2021.



OVERVIEW OF U.S. EMISSION SOURCES BY GREENHOUSE GAS

Carbon Dioxide (CO₂)

Carbon dioxide (CO₂) accounted for 79 percent of total U.S. emissions in 2021. CO₂ emissions have decreased 18 percent since 2005 and 2 percent since 1990. Fossil fuel combustion (e.g., transportation) was the largest source, accounting for 92 percent of CO₂ emissions. Changes in emissions from fossil fuel combustion have been the main factor influencing U.S. emission trends. Net carbon fluxes from the Land Use, Land-Use Change, and Forestry (LULUCF) sector provided a steady sink equivalent to 12 percent of total U.S. emissions in 2021, shown by Figure 7.

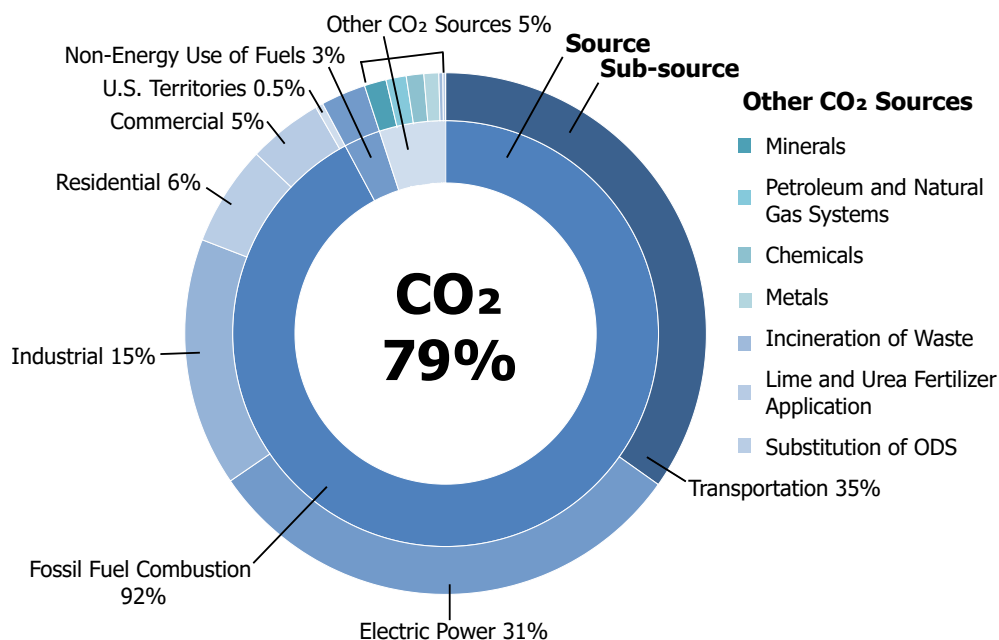


Figure 2: 2021 U.S. Sources of Carbon Dioxide (CO₂) Emissions.

Methane (CH₄)

Methane (CH₄) accounted for 12 percent of emissions in 2021. CH₄ emissions have decreased by 8 percent since 2005, 16 percent since 1990, and 2 percent from 2020 to 2021. Key trends include reduced emissions from natural gas systems due to decreases in emissions from distribution, transmission, and storage; decreases in emissions from landfills due to increased landfill gas collection and fewer decomposable materials discarded in landfills; and increased emissions from livestock in line with increasing cattle populations.

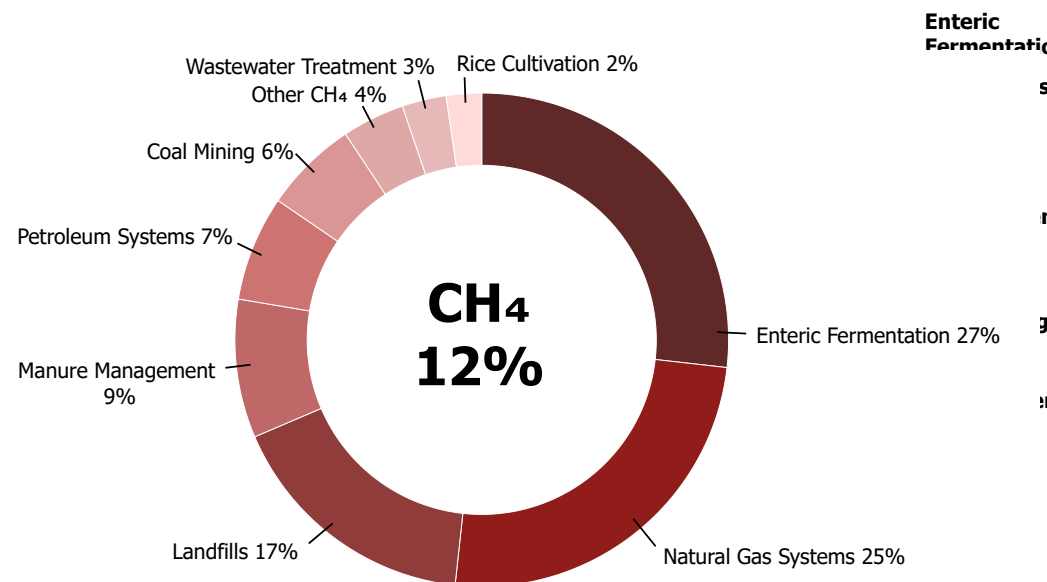


Figure 3: 2021 U.S. Sources of Methane (CH₄) Emissions, excluding CH₄ emissions from LULUCF sector from flooded lands, forest, and grassland fires.

OVERVIEW OF U.S. EMISSION SOURCES BY GREENHOUSE GAS

Nitrous Oxide (N₂O)

Nitrous Oxide (N₂O) accounted for 6 percent of total U.S. emissions in 2021. N₂O emissions have decreased by 5 percent since 2005 and 3 percent since 1990, but have increased by 1 percent in 2021. In 2021, emissions were influenced by changes in emissions from agricultural soils due to interannual weather patterns, fertilizer use, and crop production; fluctuations in livestock populations; a small decrease of N₂O emissions from stationary combustion; and impacts of national emission control standards on mobile combustion in on-road vehicles.

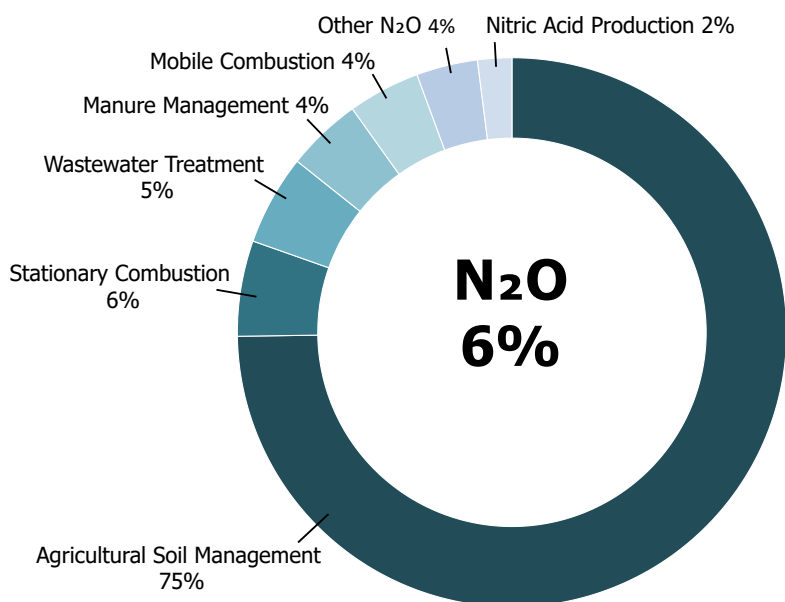


Figure 4: 2021 U.S. Sources of Nitrous Oxide (N₂O) Emissions, excluding N₂O emissions from LULUCF sources, e.g. forest, and grassland fires

Fluorinated Gases (F-gases)

Emissions of fluorinated gases (F-gases) accounted for 3 percent of emissions in 2021, and have increased by 105 percent since 1990, primarily due to the substitution of ozone depleting substances (ODS) as a result of efforts to phase out CFCs and other ODS in the U.S. Despite being emitted in smaller quantities relative to the other principal greenhouse gases, emissions of F-gases are significant because many of them have extremely high global warming potentials (GWPs), and, for some F-gases, very long atmospheric lifetimes. Ozone depleting substance (ODS) substitute emissions were the primary contributor to F-gases. Other key sources include electronics manufacturing, aluminum and magnesium production, and electrical transmission and distribution (ETD).

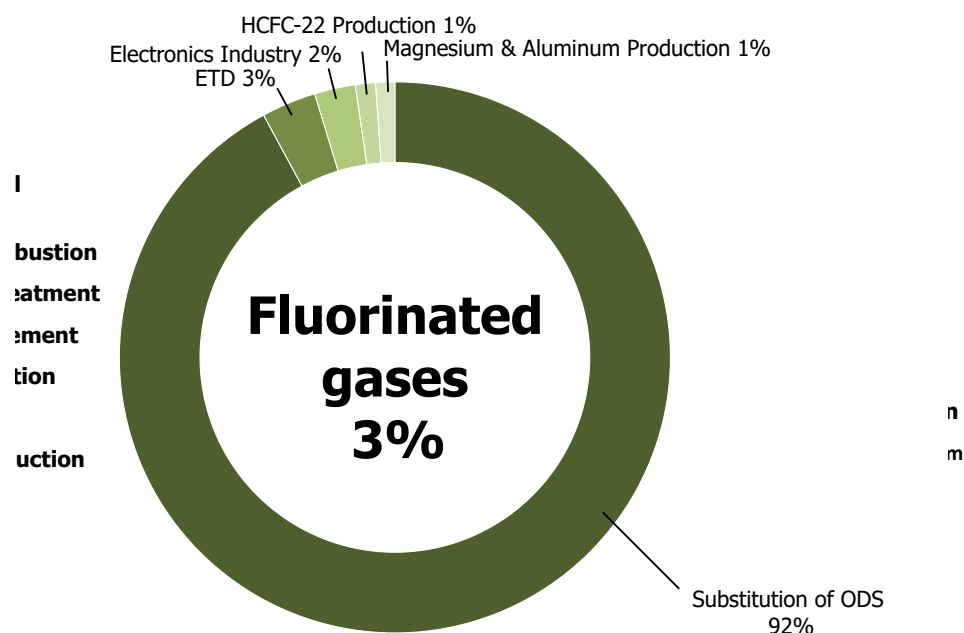


Figure 5: 2021 U.S. Sources of fluorinated gases (F-gases). ETD is Electrical Transmission and Distribution.

EMISSIONS BY ECONOMIC SECTOR

Greenhouse gases are emitted across five economic sectors: transportation, electric power (electricity generation), residential/commercial (homes and businesses), industry, and agriculture (Figure 6). U.S. territories are excluded from this figure, values, and associated percentages. The Land Use, Land-Use Change and Forestry Sector, also excluded from Figure 6, is explained following the other economic sector summaries, shown in Figure 7.

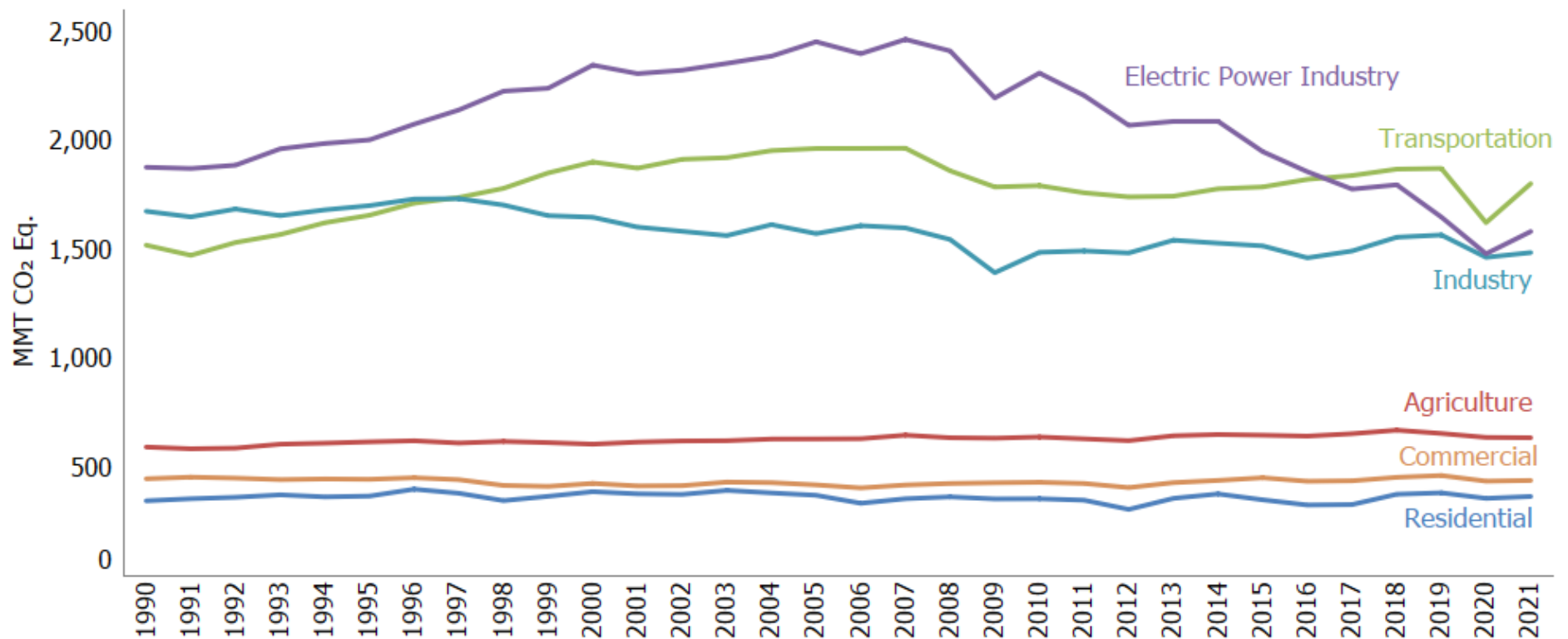


Figure 6: U.S. Greenhouse Gas Emissions Allocated to Economic Sectors

EMISSIONS BY ECONOMIC SECTOR

2020 - 2021 Change



Transportation

Transportation activities were the largest source (29 percent) of total U.S. greenhouse gas emissions in 2021. From 1990 to 2021, transportation CO₂ emissions from fossil fuel combustion increased by 19 percent. In 2021, emissions increased by 11 percent, which followed a decline of 13 percent in 2020 due to reduced travel demand during the height of the COVID-19 pandemic. In 2021, light-duty vehicles represented 58 percent of CO₂ emissions from transportation fossil fuel combustion and medium- and heavy-duty trucks and buses represented 25 percent. The remainder was due to off-road sources.

Electric Power

The electric power sector accounted for 25 percent of total U.S. greenhouse gas emissions in 2021. Emissions from the electric power sector have decreased by approximately 15 percent since 1990, and the carbon intensity of the sector, in terms of emissions (CO₂ Eq.) per QBTU input, has decreased by 25 percent. Total electric power generation increased by 3 percent in 2021 while electric power-related emissions increased by 7 percent due in part to an increase in coal consumed to produce electricity in the electric power sector. In 2021,

the consumption of natural gas for electric power generation decreased by 4 percent, while the consumption of coal and petroleum increased by 16 and 10 percent, respectively. However, even with the increase in 2021, electric power-related emissions are still lower than pre-pandemic 2019 levels.

Commercial and Residential

The commercial and residential sectors accounted for 7 and 6 percent total U.S. greenhouse gas emissions in 2021, respectively. Emissions from the commercial and residential sectors have increased since 1990 and short-term trends are often correlated with seasonal fluctuations in energy use caused by weather conditions. Total residential and commercial greenhouse gas emissions, including direct and indirect emissions, in 2021 have increased by 2% since 1990. In 2021, an increase in heating degree days (0.5 percent) increased energy demand for heating in the residential and commercial sectors, however, a 1.8 percent decrease in cooling degree days compared to 2020 reduced demand for air conditioning in the residential and commercial sectors.

Industry

The industrial sector accounted for 24 percent of U.S. greenhouse gas emissions in 2021. Since 1990, industrial sector emissions have declined by 11 percent. Structural changes within the U.S. economy that led to shifts in industrial output away from energy-intensive manufacturing products to less energy-intensive products (e.g., from steel to computer equipment) have had a significant effect on industrial emissions. In 2021, total energy use in the industrial sector increased by 2 percent due to an increase in total industrial production and manufacturing output. EPA's GHGRP data provide additional insights into underlying trends in the industrial sector.

Agriculture

Agriculture accounted for about 10 percent of U.S. greenhouse gas emissions in 2021 and includes sources such as livestock enteric fermentation and manure management, N₂O emitted from managed agricultural soils from fertilizers and other management practices, and fossil fuel combustion from agricultural equipment. In 2021, agricultural soil management was the largest source of N₂O emissions, and enteric fermentation was the largest source of CH₄ emissions in the United States.

LAND USE, LAND-USE CHANGE AND FORESTRY

Land use, land-use change, and forestry (LULUCF) activities include fluxes of carbon resulting from land use conversions (e.g., emissions from conversion of forest land to agricultural or urban use) or land use management practices that remove CO₂ from the atmosphere and store it in long-term carbon sinks (e.g., through net forest growth). Key drivers and sources of emission fluxes, including CH₄ and N₂O emissions, on managed lands include forest management practices, land use conversion, long-term storage of carbon in harvested wood products, fires, tree planting in urban areas, the management of agricultural soils, existing and new reservoirs, and other constructed waterbodies, landfilling of yard trimmings and food scraps, and activities that cause changes in coastal wetland carbon stocks. In 2021, the net CO₂ removed from the atmosphere from the LULUCF sector was 12% of total U.S. greenhouse gas emissions. Between 1990 and 2021, total carbon sequestration in the LULUCF sector decreased by 14%, primarily due to a decrease in the rate of net carbon accumulation in forests, as well as an increase in CO₂ emissions from urbanization.

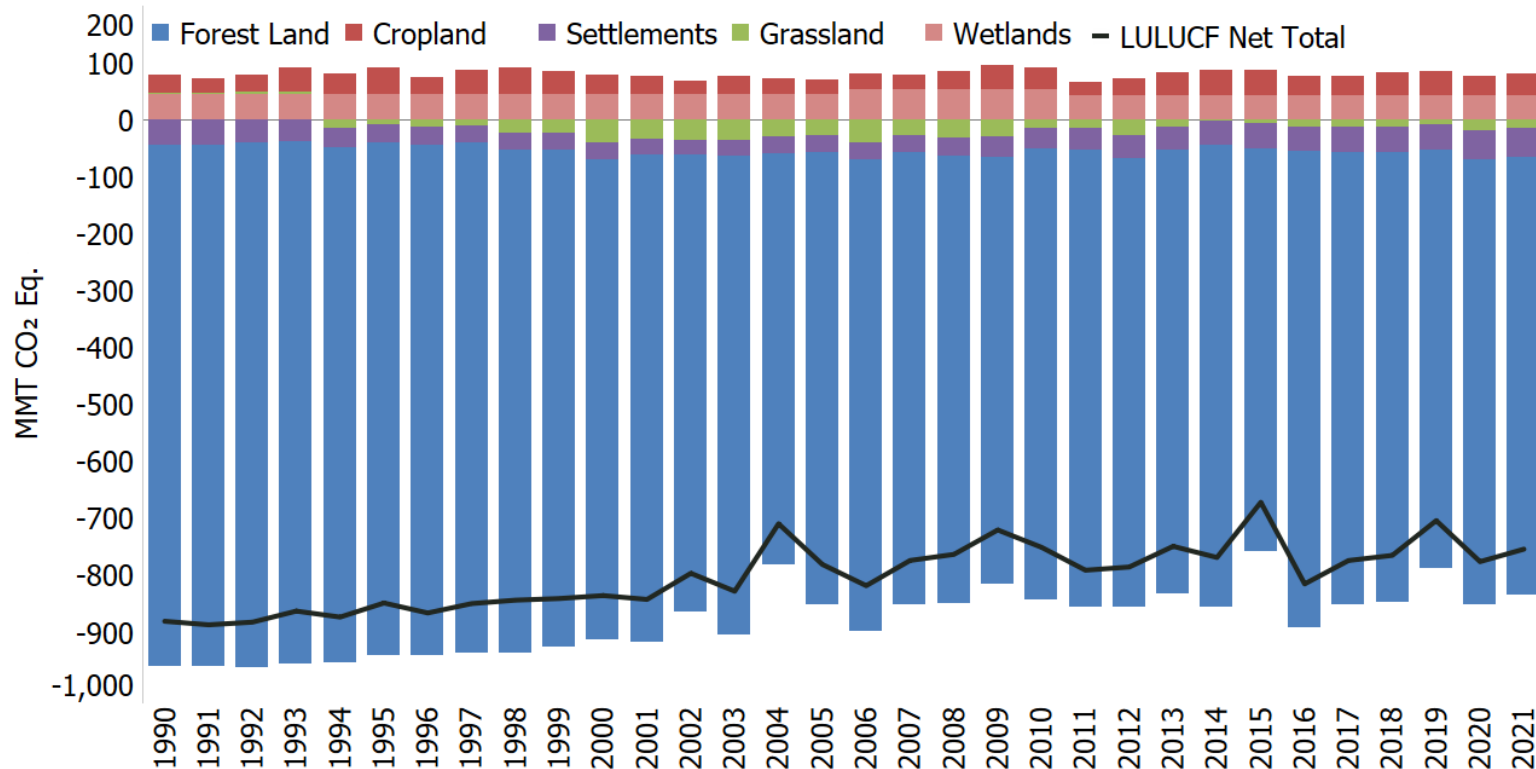


Figure 7: Trends in Emissions and Removals (Net CO₂ Flux) from Land Use, Land-Use Change, and Forestry. The term “flux” is used to describe the exchange of CO₂ to and from the atmosphere, with net flux being either positive or negative depending on the overall balance. Removal and long-term storage of CO₂ from the atmosphere is also referred to as “carbon sequestration.”

PRELIMINARY ENERGY SECTOR EMISSION DATA FOR 2022

2021 - 2022 Change (Preliminary)

Electric Power

↓
-0.4%

Transportation

↑
1.5%

Industry

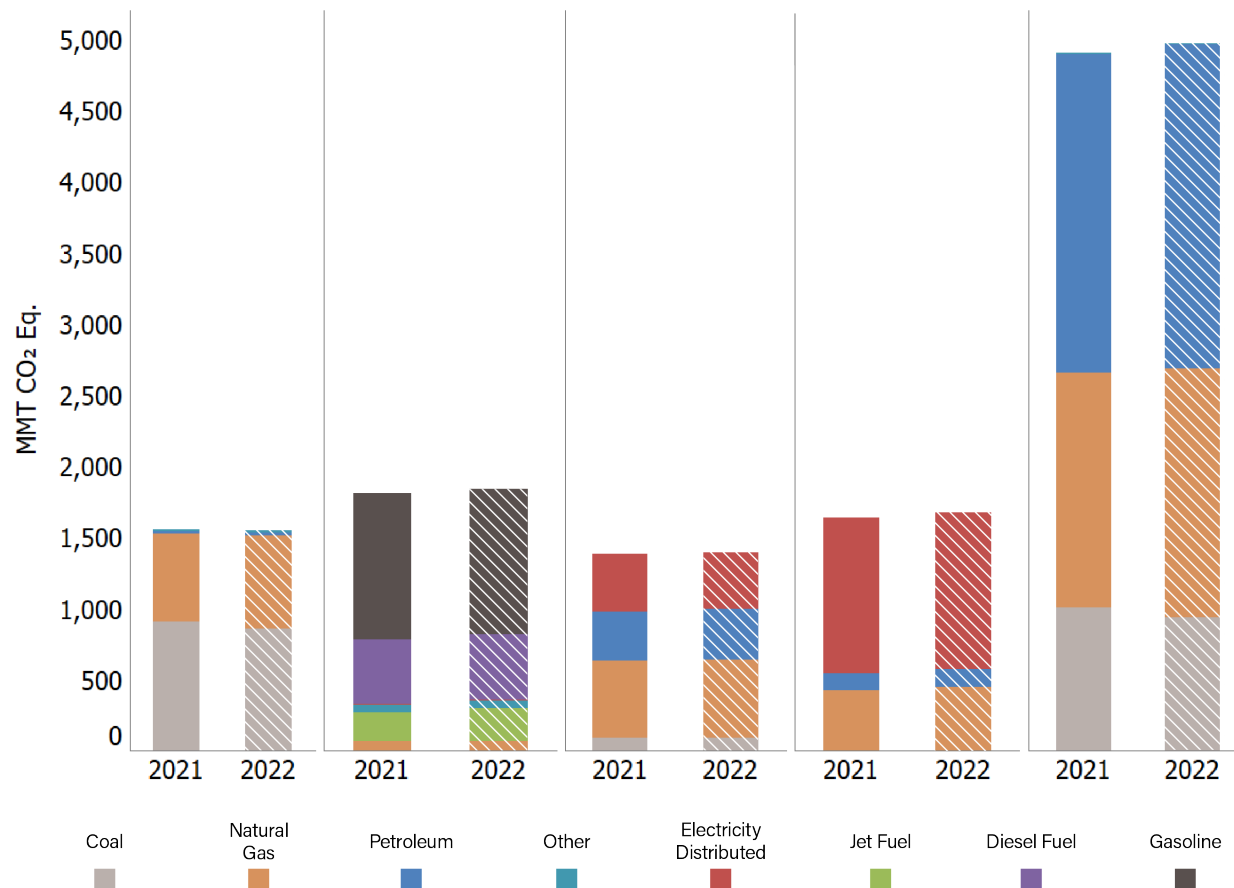
↑
1.9%

Commercial
and Residential

↑
0.6%

Total

↑
1.4%



While the current Inventory does not include 2022 estimates, preliminary energy data are available and can be used to assess likely results for energy-related CO₂ emissions. Preliminary 2022 data are not available for other sectors to provide overall projections. The preliminary energy estimates indicate that in 2022 total primary energy use increased 3 percent and emissions from energy use increased by 1 percent compared to 2021 (EIA 2023). Transportation sector emissions increased 2 percent in 2022 compared to 2021. Overall U.S. net electricity production from the electric power sector increased by 3 percent and emissions decreased by less than 1 percent in part due to decreased coal use and increased use of natural gas. In 2022, coal use decreased by about 6 percent, and natural gas use increased by about 8 percent in the electric power sector (EPA 2023). The growth in renewable sources continued with electricity production from renewable energy use increasing by about 12 percent in 2022 (EIA 2023). Emissions from the combined residential and commercial sector and from the industry sector increased by 2 percent and 1 percent respectively in 2022.

Figure 8: Comparison of Fossil Fuel CO₂ Combustion Emissions

BACKGROUND

EPA's annual Inventory of U.S. Greenhouse Gas Emissions and Sinks (the Inventory) provides a comprehensive account of emissions and removals by source, economic sector, and greenhouse gas (GHG), annually since 1990. The Data Highlights are a summary of the latest information on U.S. anthropogenic greenhouse gas emission trends from 1990 through 2021 and includes a preliminary outlook on anticipated 2022 emissions. The estimates presented are calculated using methodologies consistent with those recommended by the Intergovernmental Panel on Climate Change (IPCC).

In preparing the annual Inventory, EPA collaborates with hundreds of experts representing more than a dozen U.S. government agencies, academic institutions, industry associations, consultants, and environmental organizations. EPA also collects greenhouse gas emission data from individual facilities and suppliers of certain fossil fuels and industrial gases through its Greenhouse Gas Reporting Program (GHGRP). The GHGRP does not provide full coverage of total annual U.S. greenhouse emissions and sinks (e.g., the GHGRP excludes emissions from the agricultural, land use, and forestry sectors), but it is an important input to the calculations of national-level emissions in the Inventory.

For this latest release, EPA has made several important improvements, including updates to estimates for oil and gas and for flooded lands. In addition, for the current Inventory, CO₂-equivalent emission estimates have been updated to reflect the 100-year GWP values provided in the IPCC Fifth Assessment Report (AR5) (IPCC 2014).

FOR MORE INFORMATION

Additional resources and tools with more information and data related to the U.S. Greenhouse Gas Inventory are available at: <https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks>. These include:

- The Greenhouse Gas Inventory Data Explorer allows users to visualize the data underlying U.S. Inventory estimates,
- The full Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021 report here provides access to in-depth information on data sources and methodologies, and
- CSVs of the Inventory report tables available for download for your own use.

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